

What is claimed is:

1. A lithium secondary cell, comprising:

an internal electrode body including a hollow cylindrical winding core, a positive electrode plate and a negative electrode plate wound around an external periphery wall of the hollow cylindrical winding core with a separator disposed therebetween, a nonaqueous electrolyte solution impregnating inside the internal electrode body; a cylindrical cell case being opened at both ends for housing the internal electrode body; and two electrode caps sealing the above described internal electrode body at both ends of the cell case,

wherein two electrode caps seal the above described internal electrode body at both open ends of the cell case;

wherein each of the electrode caps is provided with a plate member sealing said internal electrode body and disposed so as to seal both open ends of the cell case, an terminal member protruding onto the surface of the above described electrode caps to lead out currents to outside, and an internal terminal member brought into connection with the internal electrode body and taking out currents from the internal electrode body; and

wherein at least two members selected from the group consisting of the plate members, the external terminal members and the internal terminal members are joined together for construction.

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3. The lithium secondary cell according to claim 1, wherein  
at least two of said plate member, said external terminal  
member and said internal terminal member are produced by a  
method selected from a group consisting of friction bonding,  
brazing, welding, clamping and forging clamping, and any  
combination of those methods.

15 5. The lithium secondary cell according to claim 1, wherein  
the central axis of said winding core is coaxial with the  
central axis of said cell case.

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7. A lithium secondary cell, comprising:

an internal electrode body including a hollow cylindrical winding core, a positive electrode plate and a negative electrode plate wound around an external periphery wall of the hollow cylindrical winding core with a separator disposed therebetween, a nonaqueous electrolyte solution impregnating inside the internal electrode body; a cylindrical cell case being opened at both ends for housing the internal electrode body; and two electrode caps sealing the above described internal electrode body at both ends of the cell case,

wherein each of two electrode caps is provided with a plate member sealing said internal electrode body and being disposed so as to seal both open ends of the cell case, an external terminal member protruding onto the surface of the electrode caps to lead out currents to outside, an internal terminal member brought into connection with the internal electrode body and taking out currents from the internal electrode body, and an elastic body; and

wherein at least two members selected from the group consisting of the plate members, the external terminal members and the internal terminal members are joined together for construction.

8. The lithium secondary cell according to claim 7, wherein said elastic body is sandwiched among any of said plate member, said external terminal member and said internal terminal member respectively.

9. The lithium secondary cell according to claim 7, wherein said elastic body insulates the positive electrode and the negative electrode electrically.

10 5 said elastic body has electric resistivity of not less than  $10^{10}$   $\Omega/\text{cm}$ .

11. The lithium secondary cell according to claim 7, wherein said elastic body is made of at least two kinds of packing having different levels of hardness.

10 12. The lithium secondary cell according to claim 7, wherein the deformation amount in direction of pressure application for bonding of said elastic body attached by pressure application for bonding is larger than the spring back amount, and said force of pressure application for bonding applied 15 to said elastic body is not more than the quantity of force making said elastic body hold elasticity maintenance percentage of 95% or more.

13. The lithium secondary cell according to claim 7, wherein said elastic body is made of any of ethylene polypropylene 20 rubber, polyethylene, polypropylene and fluoro-resin.

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15. The lithium secondary cell according to claim 7,  
wherein:

at least two of said plate member, said external terminal member, and said internal terminal member are produced by a method selected from a group consisting of friction bonding, brazing, welding, clamping and forging clamping, and any combination of those methods.

16. The lithium secondary cell according to claim 7, wherein said cell case and said electrode cap are brought into bonding by clamping processing applying pressure for bonding to the portion of said cell case in contact with said electrode cap and an outer periphery portion of said electrode cap for forming and/or welding processing to weld an end portion of said cell case and the outer periphery of said electrode cap.

an internal electrode body including a hollow cylindrical winding core, a positive electrode plate and a negative electrode plate wound around an external periphery

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20. The lithium secondary cell according to claim 17,  
5 wherein said elastic body is made of at least two kinds of  
packing having different levels of hardness.

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25. The lithium secondary cell according to claim 17,  
wherein hardness of said fixing material is the same as or  
larger than hardness of said terminal member.

27. The lithium secondary cell according to claim 17,  
wherein said terminal member has a stopper structure in order  
not to apply to said elastic body not less than constant force  
of pressure application for bonding.

28. The lithium secondary cell according to claim 17, wherein with the central axis of said terminal member being an axis,  $r_1$  (mm) being the radius of the upper end of said terminal member and  $r_2$  (mm) being the inner diameter of the upper end of said fixing material when the side on which said fixing material is disposed is placed upper than the position of said plate member being a reference,  $r_1$  and  $r_2$  preferably fulfill  $r_1 > r_2$ .



29. The lithium secondary cell according to claim 28, wherein when  $\Delta r(\text{mm})$  is a difference between said  $r_1(\text{mm})$  and said  $r_2(\text{mm})$ ,  $\Delta r$  fulfills relationship of  $\Delta r \geq 0.2 \text{ mm}$ .

30. The lithium secondary cell according to claim 17, wherein with the central axis of the terminal member being an axis, when the side on which said fixing material is disposed is placed upper than the position of said plate member being a reference, the upper end of said terminal member protrudes from the upper end of said fixing material.

31. The lithium secondary cell according to claim 17, wherein with  $M_1(\text{ton})$  being force to extract press-inserted said fixing material and  $M_2(\text{ton})$  being elastic force of said elastic body,  $M_1$  and  $M_2$  fulfill relationship of  $M_1 > M_2$ .

32. The lithium secondary cell according to claim 31, wherein said  $M_1$  and said  $M_2$  fulfill relationship of  $M_1 \geq M_2 \times 2$ .

33. The lithium secondary cell according to claim 31, wherein said  $M_1$  fulfills relationship of  $M_1 \geq 1(\text{ton})$ .

34. The lithium secondary cell according to claim 17, wherein the upper end surface of said terminal member is concave.

35. An assembly of lithium battery cells which comprises a plurality of lithium secondary cells and a plurality of bus bars bringing into connection a plurality of lithium secondary cells each of which comprises an internal electrode body including a hollow cylindrical winding core, a positive electrode plate and a negative electrode plate wound around an external periphery wall of the hollow cylindrical winding core with a separator disposed therebetween, a nonaqueous electrolyte solution impregnating inside the internal electrode body; and a cylindrical cell case housing said internal electrode body;

wherein a positive electrode external terminal member of one of the plurality of the lithium secondary cells and a negative external terminal member of the lithium secondary cells other than said one of the plurality of the lithium secondary are brought into connection with a bus bar.

36. The connecting structure body of a lithium secondary cell according to claim 35, wherein at least one of said electrode caps for each cell has a pressure release hole, respectively.

37. The connecting structure body of a lithium secondary cell according to claim 35, wherein said bus bar is bonded with a cell not so as to blockade said pressure release hole.

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the central axis of said winding core is coaxial with  
the center axis of said cell case;

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39. The connecting structure body of a lithium secondary cell according to claim 35, wherein said bus bar is bonded with said external terminal member by welding.

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wherein the bus bar and the external terminal member are bonded by welding, and the bus bar and the external member are made of same kind of metal.

41. An assembly of lithium battery cells which comprises a plurality of lithium secondary cells and a plurality of bus bars bringing into connection with bus bars a plurality of lithium secondary cells each of which comprises an internal electrode body including a hollow cylindrical winding core, a positive electrode plate and a negative electrode plate wound around an external periphery wall of the hollow cylindrical winding core with a separator disposed therebetween, a nonaqueous electrolyte solution impregnating inside the internal electrode body; and a cylindrical cell case housing said internal electrode body;

wherein the bus bar and the external terminal member are bonded by welding, and a portion of the bus bar being welded with the external terminal member and a portion of the external member being welded with the bus bar are made of same kind of metal.

42. The connecting structure body of a lithium secondary cell according to claim 41, wherein:

said external terminal members of a positive electrode and a negative electrode are made of Al or Al alloy; and

said bus bar is made of one member containing Al as a major component.

43. The connecting structure body of a lithium secondary cell according to claim 41, wherein:

said external terminal members of a positive electrode and a negative electrode are made of Cu or Cu alloy is used for; and

said bus bar is made of a member containing Cu as a major component.

44. The connecting structure body of a lithium secondary cell according to claim 41, wherein:

said external terminal members of a positive electrode and a negative electrode are made of Ni or Ni alloy; and

said bus bar is made of a member containing Ni as a major component.

45. An assembly of lithium battery cells which comprises a plurality of lithium secondary cells and a plurality of bus bars bringing into connection, by way of bonding by welding a plurality of the bus bars and the external terminal members, a plurality of lithium secondary cells each of which comprises an internal electrode body including a hollow cylindrical winding core, a positive electrode plate and a negative electrode plate wound around an external periphery wall of the hollow cylindrical winding core with a separator disposed therebetween, a nonaqueous electrolyte solution impregnating inside the internal electrode body; and a cylindrical cell case housing said internal electrode body;;

wherein the bus bar is formed by bonding different kinds of metals.

46. The connecting structure body of a lithium secondary cell according to claim 45, wherein:

5       said external terminal member in the positive electrode is made of Al or Al alloy, and said external terminal members of the negative electrode are made of Cu or Cu alloy; and

10       said bus bar is formed by bonding a member containing Al as a major component and a member containing Cu as a major component.

47. The connecting structure body of a lithium secondary cell according to claim 45, wherein:

15       said external terminal of the positive electrode is made of Al or Al alloy and said external terminal of the negative electrode is made of Ni or Ni alloy; and

      said bus bar is formed by bonding a member containing Al as a major component and a member containing Cu as a major component.

20   48. The connecting structure body of a lithium secondary cell according to claim 35, wherein said bus bar is a one produced by a method selected from a group consisting of friction bonding, brazing, welding, clamping, and forging clamping, press-insertion, enveloped casting, explosive  
25   welding and close fit, and any combination of those methods.

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an external periphery wall of the hollow cylindrical winding core with a separator disposed therebetween, a nonaqueous electrolyte solution impregnating inside the internal electrode body; and a cylindrical cell case housing the internal electrode body;

wherein a positive electrode external terminal member of one of the plurality of the lithium secondary cells and a negative external terminal member of the lithium secondary cells other than said one of the plurality of the lithium secondary cells having are brought into connection with a bus bar.

53. The connecting structure body of a lithium secondary cell according to claim 52, wherein said bus bar is a one produced by a method selected from a group consisting of friction bonding, brazing, welding, clamping, and forging clamping, press-insertion, enveloped casting, explosive welding and close fit, and any combination of those methods.